

Application Number 10/521871
Response to the Office Action dated August 18, 2008

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Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (Currently Amended) An electrolyte membrane having ionic conductivity, the electrolyte membrane comprising:
 - a base material, and
 - organic molecules containing ion exchange groups;
 - wherein the organic molecules are chemically bonded to ~~the~~ a surface of the base material to form an organic layer, ~~and~~
 - wherein ions are conducted via the ion exchange groups in the organic layer,
 - ~~wherein the base material is a porous membrane, wherein a plurality of through holes that pierce the porous membrane in the~~ a direction perpendicular to a surface of the porous membrane surface are formed in the porous membrane, ~~and~~
 - ~~wherein the organic molecules are chemically bonded to the~~ an inner surface of the through holes, ~~to form and form~~ the organic layer, ~~and~~
 - ~~wherein in the through holes organic layer, a water repellent substance is further provided on the~~ a face of the ~~membrane organic layer on the~~ a side opposite ~~the to a~~ face that is bonded to the base material, ~~so as to and the substance fills gaps present in the~~ an inner portion of the through holes.
2. (Original) The electrolyte membrane according to claim 1,
 - wherein the ion exchange groups include at least one type of functional group selected from phosphonyl, phosphinyl, sulfonyl, sulfinyl, carboxyl, phosphone, phosphine, sulfone, sulfine, mercapto, ether bonding, nitro, hydroxy, quaternary ammonia, amino and phosphoric acid groups.
3. (Currently Amended) The electrolyte membrane according to claim 1,
 - wherein ~~the~~ molecular weight of the organic molecules is 10,000 at most.

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4. (Original) The electrolyte membrane according to claim 1,
wherein the organic molecules are chemically bonded to the surface of the base material by a coupling agent.
5. (Original) The electrolyte membrane according to claim 1,
wherein at least one of the organic molecules is chemically bonded to an adjacent organic molecule.
6. (Currently Amended) The electrolyte membrane according to claim 1,
wherein ~~the~~ a thickness of the organic layer is in a range of at least 0.1 nm to at most 500 nm.
7. (Original) The electrolyte membrane according to claim 1, wherein the organic layer is a monolayer.
8. (Original) The electrolyte membrane according to claim 1, wherein the organic layer is a bilayer or multilayer that includes a structure in which a plurality of monolayers are built-up.
9. (Original) The electrolyte membrane according to claim 1, wherein the base material has at least one form selected from particles or fibres, and wherein the electrolyte membrane includes an amalgamation of the base material.
10. (Cancelled)
11. (Original) The electrolyte membrane according to claim 1, wherein the base material has a folded film shape.

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12. (Currently Amended) The electrolyte membrane according to claim 11, wherein a the surface of the base material and ~~the~~ a surface of the electrolyte membrane are perpendicular to each other.

13. (Original) The electrolyte membrane according to claim 11, wherein the base material is wound-up.

14. (Currently Amended) The electrolyte ~~membrane~~ membrane according to claim 11, wherein the base material is folded into an accordion shape.

15-16. (Cancelled)

17. (Currently Amended) The electrolyte membrane according to claim 1,
wherein ~~the~~ a cross-sectional area of the through holes that are cut in a direction that is parallel to the surface of the porous membrane changes in ~~the~~ a thickness direction of the porous membrane.

18. (Previously Presented) The electrolyte membrane according to claim 1,
wherein fine holes that are connected to the through holes are further formed in the porous membrane, and
wherein both ends of the fine holes are open ended.

19. (Original) The electrolyte membrane according to claim 18, wherein both ends of the fine holes are connected to the through holes.

20. (Currently Amended) The electrolyte membrane according to claim 18, wherein one end of the fine holes is connected to the through holes and ~~the~~ other end of the fine holes is connected to the surface of the porous membrane.

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21. (Original) The electrolyte membrane according to claim 1, wherein the base material includes at least one type of material selected from metal, metal oxide, glass, ceramic, clay, carbon, resin and silica.

22. (Original) The electrolyte membrane according to claim 21, wherein the base material includes at least one type of material chosen from an oxide of a transition metal, alumina, fluorocarbon resin, aramid resin, silicone resin, amide resin, imide resin and melamine resin.

23. (Original) The electrolyte membrane according to claim 1, which includes a plurality of base materials.

24. (Original) The electrolyte membrane according to claim 1, wherein the specific surface area per unit volume of base material, measured by gas adsorption method, is at least $100 \text{ m}^2/\text{cm}^3$.

25. (Currently Amended) The electrolyte membrane according to claim 1, wherein when the porosity of the base material is ϵ (volume %) and the an average diameter of the through holes is d (nm), ϵ and d satisfy the a relationship given by $(4 \times \epsilon) / d > 10$.

26. (Currently Amended) The electrolyte membrane according to claim 1, wherein when the porosity of the base material is ϵ (volume %), and the an average tortuosity of the through holes is τ , ϵ and τ satisfy the relationship given by $\epsilon / \tau^2 < 20$.

27. (Cancelled)

28. (Cancelled)

29. (Cancelled)

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30. (Original) A membrane electrode assembly, comprising:

an electrolyte membrane according to claim 1;

a cathode electrode; and

an anode electrode;

wherein the electrolyte membrane is disposed between the cathode electrode and the anode electrode.

31. (Currently Amended) A fuel cell, comprising:

an electrolyte membrane according to claim 1;

a cathode electrode; and

an anode electrode;

wherein the electrolyte membrane is held between the cathode electrode and the anode electrode; and further comprising:

a fuel supply portion ~~to supply that supplies~~ fuel to the anode electrode, and an oxidizing agent supply portion ~~to supply that supplies~~ an oxidizing agent to the cathode electrode.

32. (Currently Amended) The fuel cell according to claim 31,

wherein ~~the~~ fuel includes at least one type of gas or liquid selected from hydrogen and hydrocarbon.

33. (Original) The fuel cell according to claim 32, wherein the fuel includes methanol.

34. (New) An electrolyte membrane having ionic conductivity, the electrolyte membrane comprising:

a base material, and

organic molecules containing ion exchange groups;

wherein the organic molecules are chemically bonded to a surface of the base material to form an organic layer,

wherein ions are conducted via the ion exchange groups in the organic layer,

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the base material is a porous membrane, wherein a plurality of through holes that pierce the porous membrane in a direction perpendicular to a surface of the porous membrane are formed in the porous membrane,

the organic molecules are chemically bonded to an inner surface of the through holes and form the organic layer, and

in the through holes, a substance is further provided on a face of the organic layer on a side opposite to a face that is bonded to the base material, and the substance fills gaps present in an inner portion of the through holes, the substance being a polymer of at least one type of inorganic materials.

35. (New) An electrolyte membrane having ionic conductivity, the electrolyte membrane comprising:

a base material, and

organic molecules containing ion exchange groups;

wherein the organic molecules are chemically bonded to a surface of the base material to form an organic layer,

wherein ions are conducted via the ion exchange groups in the organic layer,

the base material is a porous membrane, wherein a plurality of through holes that pierce the porous membrane in a direction perpendicular to a surface of the porous membrane are formed in the porous membrane,

the organic molecules are chemically bonded to an inner surface of the through holes and form the organic layer, and

in the through holes, a substance is further provided on a face of the organic layer on a side opposite to a face that is bonded to the base material, and the substance fills gaps present in an inner portion of the through holes, the substance being a polymer of at least one material selected from styrene, divinylbenzene, and methyl methacrylate, and at least one part of the selected material may be substituted with fluorine.